

BRIGHTLUX

COB vs MiP vs SMD

LED Technology Comparison & Specification Guide

A comprehensive guide for architects, consultants, and AV specifiers.
Covers technology fundamentals, specification criteria, and UAE/GCC application guidance.

2026 Edition | For Professional Use Only

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1. TECHNOLOGY OVERVIEW

SMD (Surface Mount Device)

SMD is the traditional and most widely deployed LED display technology. Individual red, green, and blue LED chips are packaged into a single surface-mount component, then soldered onto a PCB. SMD has been the industry standard for over 15 years and remains the most cost-effective option for pixel pitches above 1.5mm.

- Individual RGB LEDs in plastic packages soldered onto PCB
- Mature supply chain, lowest cost per sqm for pitches > 1.5mm
- Easy single-LED repair in field (technician can replace one LED)
- Contrast ratio typically 3,000:1 to 5,000:1
- Susceptible to moisture and dust ingress at LED level
- Best for: outdoor displays, rental/events, large-pitch indoor (P2.5+)

COB (Chip-on-Board)

COB eliminates individual LED packaging entirely. Bare LED chips are mounted directly onto the PCB substrate and encapsulated with a resin/epoxy layer. This produces a smooth, seamless surface with dramatically better contrast and protection. COB is the premium choice for fine-pitch applications where image quality is paramount.

- Bare LED chips bonded directly to PCB, covered by protective resin
- Superior contrast ratio: 15,000:1 to 20,000:1+
- Inherently dust-proof and moisture-resistant (IP40+ at panel level)
- 30-40% lower power consumption vs equivalent SMD
- 160+ degree wide viewing angle with no colour shift
- Repair is module-level (not single LED) - higher repair cost
- Best for: control rooms, broadcast, boardrooms, home cinema, medical

MiP (Mini LED in Package)

MiP represents the newest generation, combining advantages of both SMD and COB. Mini LED chips are individually packaged (like SMD) but at a much smaller scale, achieving COB-like contrast while maintaining field serviceability. MiP is the fastest-growing LED technology in 2025-2026.

- Mini LED chips in ultra-compact individual packages
- Contrast ratio: 8,000:1 to 12,000:1 (approaching COB)
- Single-LED field repair possible (unlike COB)
- 25-35% power savings vs traditional SMD
- Compatible with active-matrix driving (smoother gradients)
- Mass production scaling rapidly - costs decreasing
- Best for: retail flagships, broadcast, medical imaging, defence

2. HEAD-TO-HEAD COMPARISON

Specification	SMD	COB	MiP
Min Pixel Pitch	0.9mm	0.4mm	0.4mm
Contrast Ratio	3,000-5,000:1	15,000-20,000:1	8,000-12,000:1
Black Uniformity	Fair (LED caps visible)	Excellent (smooth surface)	Very Good
Power Consumption	Baseline (100%)	60-70% of SMD	65-75% of SMD
Viewing Angle	140-160 degrees	160+ degrees	160+ degrees
Moisture Protection	Low (exposed LEDs)	High (resin coating)	Medium-High
Dust Resistance	Low	Excellent	Good
Field Repair	Single LED	Module replacement	Single LED
Repair Cost	Low	Medium-High	Low-Medium
Lifespan	50,000-80,000 hrs	100,000+ hrs	80,000-100,000 hrs
Cost per sqm (P1.2)	USD 2,500-4,000	USD 5,000-8,000	USD 3,500-6,000
Colour Accuracy	Good (DCI-P3 80%+)	Excellent (DCI-P3 95%+)	Very Good (DCI-P3 90%+)
Refresh Rate	1,920-3,840 Hz	3,840-7,680 Hz	3,840-7,680 Hz
UAE Suitability	Good for outdoor	Best for indoor premium	Versatile indoor

3. WHEN TO SPECIFY EACH TECHNOLOGY

Choose SMD when:

- Budget is the primary constraint
- Pixel pitch is 1.5mm or larger
- Application is outdoor or rental/events
- On-site single-LED repair is required
- Content is mostly text, simple graphics, or from a distance

Choose COB when:

- Image quality and contrast are paramount
- Pixel pitch is sub-1.2mm (control rooms, boardrooms)
- Environment is dusty or humid (warehouse, industrial)
- Display will be on 16+ hours/day (lifespan matters)
- Content includes fine detail, medical imaging, or broadcast
- Budget allows for premium specification

Choose MiP when:

- You want COB-level quality with SMD-level serviceability
- Fine pitch (0.7-1.5mm) with field repair requirement
- Retail flagship or brand experience environment
- Camera-friendly applications (broadcast, streaming)
- Mid-high budget with long-term total cost optimization

4. UAE & GCC CLIMATE CONSIDERATIONS

The Gulf region presents unique challenges for LED display specification:

- Ambient temperatures regularly exceed 45C in summer - ensure operating range covers -10C to +55C
- Fine sand and dust require IP54+ rating for semi-outdoor; IP65+ for outdoor
- Direct sunlight intensity in Dubai exceeds 100,000 lux - outdoor displays need 5,000+ nits minimum
- Air-conditioned interiors can create condensation on external-facing glass - consider anti-condensation heating for transparent LED
- Power supply must handle 220V/50Hz with surge protection (common power fluctuations)
- Front-service access is critical for high-rise installations common in Dubai/Abu Dhabi
- Salt-air corrosion near coastal areas (JBR, Palm, Saadiyat) - specify marine-grade connectors

5. VIEWING DISTANCE & PIXEL PITCH MATRIX

Minimum comfortable viewing distance = Pixel Pitch (mm) x 1.5 metres

Application	Viewing Distance	Recommended Pitch	Technology
Control Room (24/7)	1.5 - 3m	P0.7 - P1.2	COB / MiP
Boardroom / Meeting	2 - 5m	P1.2 - P1.8	COB / MiP
Retail Close-up	1 - 3m	P0.9 - P1.5	MiP / COB
Lobby Feature Wall	3 - 8m	P1.5 - P2.5	MiP / SMD
Auditorium / Ballroom	5 - 15m	P2.5 - P3.9	SMD / MiP
Outdoor Billboard	10 - 50m	P4 - P10	SMD
Stadium / Arena	20 - 100m	P6 - P16	SMD

6. WHAT TO ASK THE VENDOR

Use this checklist when evaluating LED display proposals:

01. What is the actual measured contrast ratio (ANSI, not sequential)?
02. What LED chip brand is used? (Nationstar, Cree, Epistar, etc.)
03. What is the driver IC? (MBI, Chipone, etc.) - affects grayscale and refresh
04. Is front-service available without removing the entire module?
05. What is the actual power consumption at 60% white (not max)?
06. What redundancy is built in? (dual power, dual data, hot-swap)
07. What is the warranty period and what does it cover?
08. Can you provide on-site spare modules (5-10% of total)?
09. What control system is included? (Novastar, Colorlight, Brompton)
10. Is calibration included at install? What about re-calibration schedule?
11. What is the module/cabinet size? Does it fit my structural grid?
12. What are the heat dissipation requirements? (HVAC impact)
13. What certifications do you hold? (CE, FCC, UL, EMC, RoHS)
14. Do you provide BIM/CAD files for architectural coordination?
15. What is the lead time for this specific configuration?

7. SPECIFICATION CHECKLIST

Include these items in your LED display specification:

Item	Specify
Display Type	SMD / COB / MiP / Transparent
Pixel Pitch	e.g., P1.2, P2.5, P4
Active Area	Width x Height in mm
Resolution	Pixels horizontal x vertical
Brightness	Nits (cd/m2) - specify calibrated value
Contrast Ratio	ANSI contrast, not dynamic/sequential
Refresh Rate	Hz - specify for camera-friendly if needed
Colour Temp	Default and adjustable range (e.g., 3200K-9300K)
IP Rating	Front and rear separately
Operating Temp	Range in Celsius
Power	Max and typical W/sqm
Service Access	Front / Rear / Both
Redundancy	Power, data, receiving card
Control System	Brand and model
Cabinet / Module	Dimensions, material, weight
Mounting	Method, structural requirements
Content Input	HDMI, DVI, SDI, IP/streaming
Certifications	CE, FCC, UL, RoHS, EMC

Item	Specify
Warranty	Period, coverage, SLA
Spare Parts	% included, availability commitment

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For custom specification assistance, contact our technical team for a design-assist consultation.